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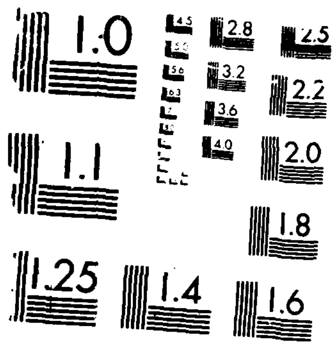

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Technical Note 7-87

USER PERCEPTIONS OF SIDE-ARM FLIGHT CONTROL IN ROTARY-WING AIRCRAFT

John K. Schmidt
Paul E. Elliott
William B. DeBellis

October 1987
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U. S. ARMY HUMAN ENGINEERING LABORATORY
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It is anticipated that conventional primary flight controls will be replaced by side-arm devices in future rotary-wing aircraft. Side-arm controls are projected to have certain ergonomic advantages that will greatly enhance a helicopter pilot's mission capability. Several studies have been conducted to test their feasibility, their handling qualities, and the optimal configuration; but little work has been done to anticipate what human factors implications side-arm controls will have once integrated into the cockpit. Sixteen scout and attack helicopter pilots were interviewed regarding side-arm primary flight controls. Interviewee responses reflected some new as well as already identified problem areas. The authors suggest that these issues be addressed before actual implementation is made.

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October 1987

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CONTENTS

USER PERCEPTIONS OF SIDE-ARM FLIGHT CONTROL IN ROTARY-WING AIRCRAFT

INTRODUCTION

Since the late fifties, the U.S. Government has been engaged in collaborative research with industry developing a side-arm primary flight control to replace traditional center-sticks. The impetus came from projected spacecraft requirements, because it was contended that body movement must be limited to reduce pilot effort and conserve space. Over the years, other benefits have been recognized; and, as a result, the side-arm control's intended use has spread to include other aircraft (Sjoberg, Russell, & Alford, 1957; Geiselhart, Kemmerling, Cronburg, & Thorburn, 1970).

Besides reducing required body movement, a side-arm device would remove a significant physical and visual obstruction from the cockpit. Eliminating the physical encumbrance would increase space, permitting a greater anthropometric range of pilots and room for additional avionics. Furthermore, it should improve ingress and egress, crash survivability, posture for sustained operations, and performance in low-level and "high-G" flight. Reducing the visual obstruction in the panel viewing area would free space for additional displays, permit better ergonomic design and arrangement of displays, and decrease panel dimensions (Black & Moorhouse, 1979; Sinclair & Morgan, 1981; Aiken, 1986; DeBellis, 1986).

However, such a change might be costly in terms of pilot retraining as well as retrofitting of aircraft. Further, regardless of their apparent advantages, side-arm controls must be proven to be as effective as center-sticks to warrant their implementation. Finally, if they are proven cost-effective, negative habit transfer may still pose a great operational problem, especially in emergency and disorientation situations (Geiselhart et al., 1970; Black & Moorhouse, 1979; Sinclair & Morgan, 1981; Aiken, 1986).

The advent of fly-by-wire and fly-by-light technologies intensified interest in developing an effective side-arm primary flight control (Hall & Smith, 1975; Sinclair & Morgan, 1981). Now, flight inputs could be modulated to improve aircraft-handling qualities and reduce pilot workload. Further, direct system control as opposed to mechanical and hydraulic linkages could improve system reliability (fewer moving parts), reduce maintenance, and increase system responsiveness. In addition, it would reduce overall airframe weight and permit full integration of two or more primary flight control functions.

Early investigations, which primarily consisted of tracking studies, found that a control located at a subject's side generally showed improved performance over a control positioned centrally (Geiselhart et al., 1970). It was also determined that controls providing small amounts of displacement and controls that are compact were preferred because subjects tended to overcontrol isometric, extended-displacement, and larger-scale devices. Subsequent fixed-wing simulation studies and operational tests demonstrated the feasibility of side-arm control under flight conditions but generated some additional concerns (Geiselhart et al., 1970; Hall & Smith, 1975; Black & Moorhouse, 1979). Some frequently asked questions were what hand should control, are two redundant sticks to be provided, does it cause fatigue over long durations even with support, what breakout and

resistance forces are to be implemented, how much displacement is needed, and what anthropometric design considerations are to be made.

The Army's Advanced Digital/Optical Control System (ADOCS) program was established to develop a battlefield-compatible advanced flight control system that can increase aircraft mission effectiveness through decreased pilot workload and improved handling qualities. To date, one emphasis has been on developing a feasible side-arm control for rotary-wing aircraft that exhibits handling qualities at least equivalent to conventional controls (Aiken, 1986). The Aviation and Air Defense Division of the Human Engineering Laboratory at Aberdeen Proving Ground, Maryland, has been actively engaged in a research program to identify the ergonomic design parameters for multiaxis, side-arm primary flight controls and to determine the optimal design in order to enhance mission performance. Thus far, studies have been conducted to establish what their optimal placement is with respect to comfort and fatigue, what the controller switch perturbation effects are on tracking performance, and how wearing protective gloves affects control operation (DeBellis, 1987-a, 1987-b; DeBellis & Christ, 1983). It is important to note that multiaxis, side-arm devices are not yet in the Army rotary-wing inventory. The only exception is a side-arm cyclic found in the gunner station of the Cobra attack helicopter (AH-1) (see Figure 1). It was implemented to allow space for the armament sighting device. (See Figure 2 for comparison.) Despite their anticipated advantages, side-arm primary flight controls have been omitted because of a lack of maturity in the technology. However, they are expected to be integrated into the new Light Helicopter Family (LHX) of aircraft, and human factors research to support their effective implementation must be conducted (Harvey, 1987).

OBJECTIVES

In an effort to obtain user inputs to develop a questionnaire identifying human factors research areas, interviews were conducted at Hanchey Field, Fort Rucker, Alabama. The intent was to draw upon the experience of veteran AH-1 pilots using the hydraulic and mechanically linked cyclic to pinpoint possible ergonomic considerations in side-arm control design. In addition, the impressions of Kiowa observation helicopter (OH-58) pilots were obtained to provide contrast because the OH-58's side-by-side arrangement and conventional control configuration may influence pilot perceptions. (See Figure 3 for comparison.)

METHODS

Subjects

Eight scout and eight attack helicopter instructor pilots (IPs) at Hanchey Field, primarily experienced in flying AH-1s (Cobras) and OH-58s (Kiowas) were interviewed in this preliminary study. Subject selection was based on three minimum criteria: (a) current rating - IP or higher, (b) aviation experience - 500 flight hours or more, and (c) primary aircraft flown - AH-1 or OH-58. The authors contended that aviation experience and aircraft familiarity would yield highly valid perceptions of possible change effects. The sample breakdown by

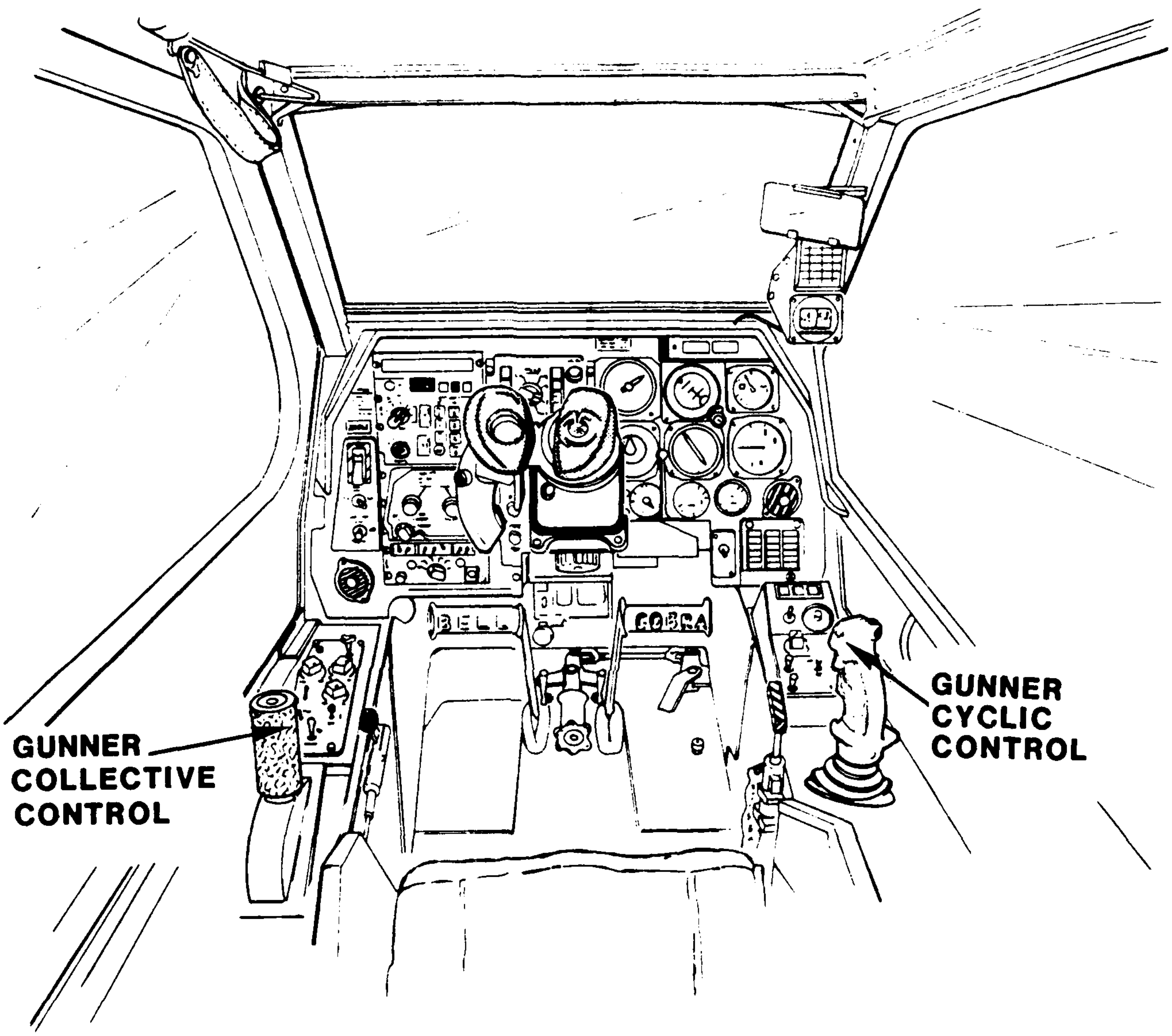

Figure 1. Gunner crew station layout, AH-1S.
(Adapted from Technical Manual 55-1520-236-10, p. 2-8.)

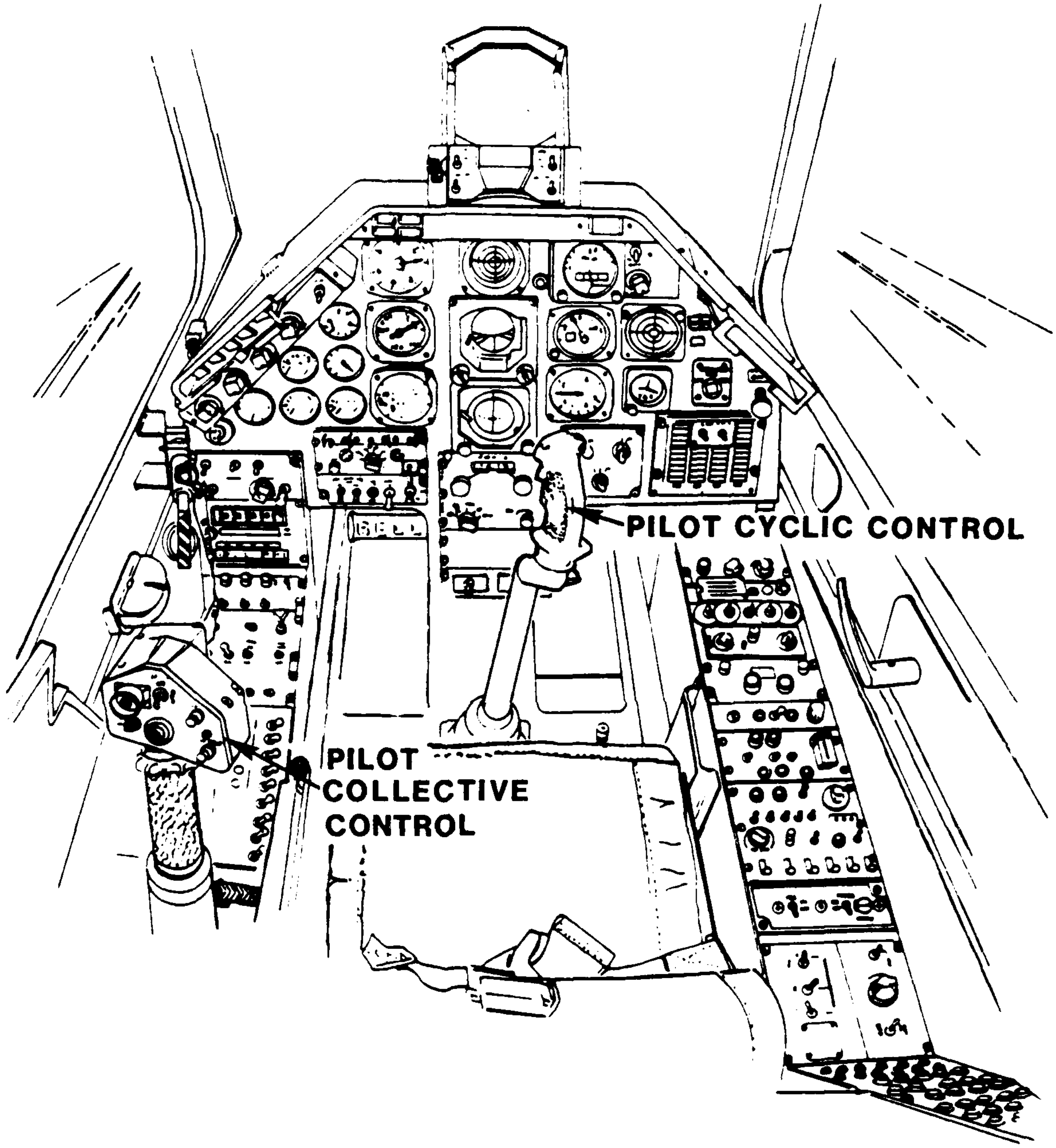

Figure 2. Pilot crew station layout, AH-1S.
(Adapted from Technical Manual 55-1520-236-10, p. 2-7.)

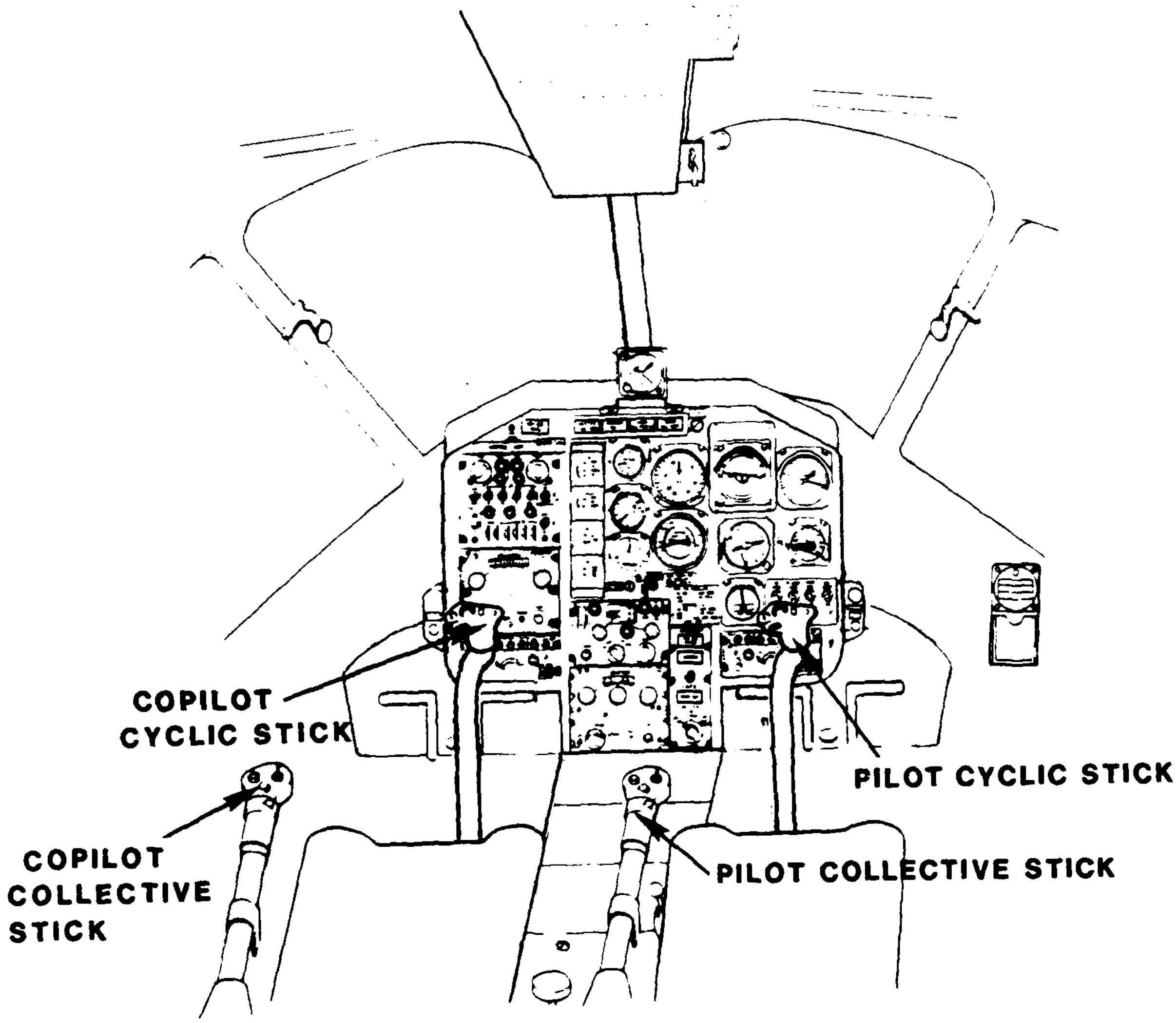

Figure 3. Crew station layout, OH-58A.
(Adapted from Technical Manual 55-1520-228-10, p. 2-4.)

demographic characteristics is presented in Table 1. All subjects were veteran aviators, but their degree of experience varied greatly.

Table 1

Sample Demographics

Variable	Range	Mean
Rank	CW2 - CPT	--[b]
Rating	IP - SIP[a]	--
Age (years)	23 - 38	31
Length of aviation service (years)	3 - 18	8
Flight experience (hours)	680 - 8,000	2,558

[a] IP = instructor pilot; SIP = standardization instructor pilot.
[b] Data are not applicable.

Instrument

The structured interview is in Appendix A. The demographics portion was used to screen potential interviewees as well as to classify responses for subsequent tabulation and analysis. Open-ended questions were used to permit interviewees to list any concerns they had about primary flight control design, to make recommendations for future switch and button placement on such controls, and to add any additional comments that came to mind.

Procedure

The subjects were given a short briefing on the Human Engineering Laboratory and its mission as well as the Aviation and Air Defense Division's role within the Laboratory. Next, they were instructed to read the opening paragraph on the interview sheet and, upon completion, were asked if they had any questions. The IPs were asked to supply the demographic data requested. Once they completed the demographic items, the interview questions were administered to them orally ensuring a standardized presentation of all items. Interview time slots were 30 minutes in length, and each took about 25 minutes to conduct. Subjects were encouraged to make additional comments to expand on previously asked questions. All subjects were interviewed over two days at Hanchey Field.

Analysis

All interviews were tabulated according to their response content and aircraft flown, either AH-1 or OH-58. Additional comments of interest were listed separately.

RESULTS

Individual responses and respective frequencies for interview items are presented in Tables 2 through 5.

Table 2

User Perceptions of Side-Arm Primary Flight Control

Responses	Number of Responses AH-1 (n=8)	OH-58 (n=8)	All (n=16)
Advantages			
Clears cockpit of obstructions	8	4	12
Opens cockpit for additional equipment	3	6	9
Permits a larger anthropometric range	0	4	4
Reduces overall space requirements	0	4	4
Improves ingress and egress	4	0	4
Disadvantages			
Increases pilot retraining	7	7	14
Creates negative habit transfer	7	7	14
Causes disorientation	0	4	4
Reduces control feel	0	4	4

Table 3

User Perceptions of Multiaxis Primary Flight Control

Responses	Number of Responses AH-1 (n=8)	OH-58 (n=8)	All (n=16)
Advantages			
Frees one hand and both feet	6	8	14
Provides additional space	1	5	6
Reduces workload	0	4	4
Reduces fatigue	0	4	4
Provides no benefit at all	2	0	2
Disadvantages			
Increases pilot retraining	8	7	15
Creates negative habit transfer	8	7	15
Causes cross-coupling	4	5	9
Causes inadvertent control inputs	4	5	9
Causes overcontrolling	5	4	9
Increases workload	4	0	4

Table 4

User Perceptions of Isometric Primary Flight Control

Responses	Number of Responses AH-1 (n=8)	OH-58 (n=8)	All (n=16)
Advantages			
Reduces movement	2	2	4
Minimizes fatigue	2	2	4
Reduces space requirements	0	2	2
Provides no advantage at all	6	5	11
Disadvantages			
Reduces feedback	5	7	12
Increases pilot retraining	2	2	4
Creates negative habit transfer	1	1	2

Table 5

User Perceptions of Button and Switch Placement on Primary Flight Controls

Responses	Number of Responses AH-1 (n=8)	OH-58 (n=8)	All (n=16)
Standardization is required	8	8	16
Better design/optimized placement	8	8	16
Too many switches	4	0	4

In response to the last item concerning any additional comments or observations that they felt might be pertinent to human factors concerns, the following questions were asked:

If a side-arm device is used, what hand will control?

Will the multiaxis control be augmented with a display to facilitate its operation?

Since controls will be fly-by-light and computer-modulated, will control characteristics be variable?

How will these "technological wonders" be maintained on the modern day battlefield and by whom?

DISCUSSION

Overall, the results suggest there is much concurrence between the potential benefits as well as the drawbacks identified by both cockpit designers and pilots. They generally found that a side-arm primary flight control would clear the cockpit of obstructions that limit display visibility and control access, and that making the control multiaxis (4-axis) would free a hand and the feet for other mission functions; however, they found no real advantage to an isometric control feature. The greatest reservations for side-arm as well as multiaxis control were pilot retraining and the negative transfer of habits. The concern for the lack of feedback was raised with regard to an isometric device.

A closer analysis of the data broken out by primary aircraft flown tells a somewhat different story. AH-1 pilots, with their tandem seating arrangement, had a different outlook than OH-58 pilots, with their side-by-side seating arrangement. Despite both AH-1 and OH-58 pilots finding that the side-arm placement would clear out the cockpit, OH-58 pilots thought the space created would be sufficient to warrant the addition of other equipment, the inclusion of physically larger personnel, or the reduction of overall cockpit size. The cramped AH-1 pilots felt that the removal of the center-stick would facilitate ingress and egress; whereas, the OH-58 pilots did not cite this as a problem to be improved upon. Finally, OH-58 pilots observed that change would cause disorientation and reduce the feeling of control as opposed to AH-1 pilots who did not see that as a problem. It appears that a pilot's primary aircraft influences his perception of what effects modifications to a cockpit will have.

The pilots interviewed generally cited that the lack of standardization in primary flight control design with respect to switch and button placement is a significant problem. Standardization is a long-standing issue for different airframes and more recently for individual models of the same aircraft. A comparison of the cyclic heads for the AH-1S and the OH-58A helicopters (see Figures 4 and 5) clearly demonstrates that primary flight controls vary not only in shape but also in general switch placement for different aircraft. Further, a comparison of the collective heads for the "A" and "C" models of the OH-58 depicts this same problem for separate models of the same basic airframe (see Figures 6 and 7). Many costly mishaps have occurred because of the misrecognition of switches and buttons on flight controls. For example, an incident occurred where the pressing of the wrong switch due to negative habit transfer caused a sling-loaded howitzer to be inadvertently released and destroyed (U.S. Army Safety Center, 1986). The article asserts that training is the answer to eliminating such problems; the present authors argue that standardization is the only true solution to negative habit transfer. Pilots also cited that switches were poorly positioned on conventional control heads and that a combined primary flight control probably posed an even greater problem. Future control designs should focus on standardization as well as optimization of switch and button arrangements.

The findings interpreted from the interviews were used to develop a flight controller questionnaire for the aviation community (see Appendix B). The authors hope that the survey will elicit further information on the more salient, unaddressed issues impacting the integration of a multiaxis, side-arm primary

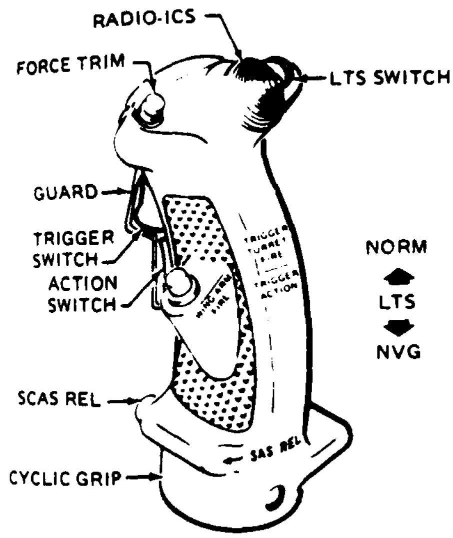

Figure 4. Pilot cyclic control, AH-1S.
(Adapted from Technical Manual 55-1520-236-10, p. 2-13.)

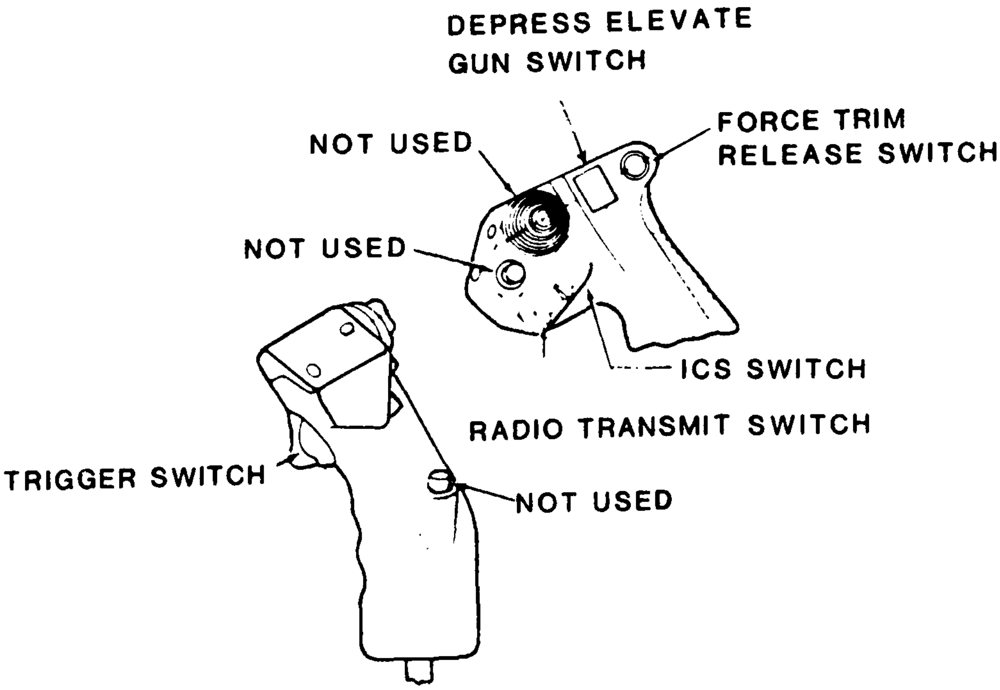

Figure 5. Pilot cyclic control, OH-58A.
(Adapted from Technical Manual 55-1520-228-10, p. 2-5.)

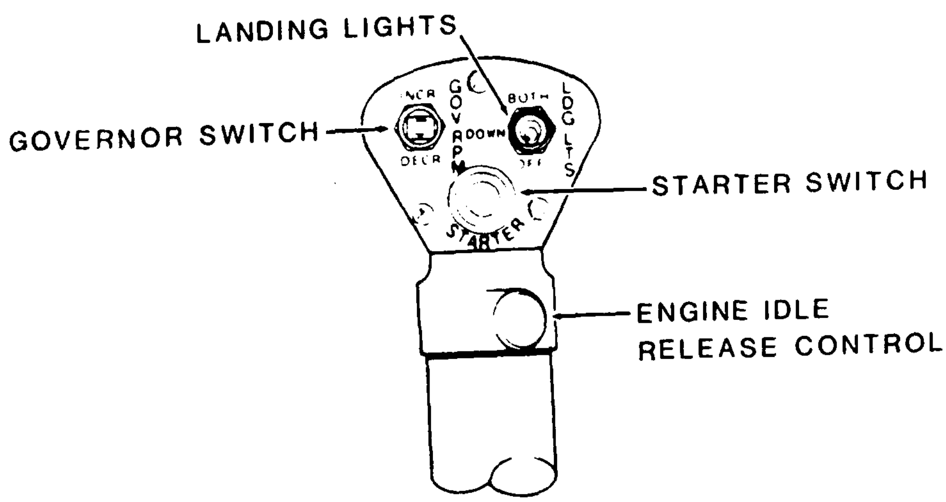

Figure 6. Pilot collective control, OH-58A.
(Adapted from Technical Manual 55-1520-228-10, p. 2-5.)

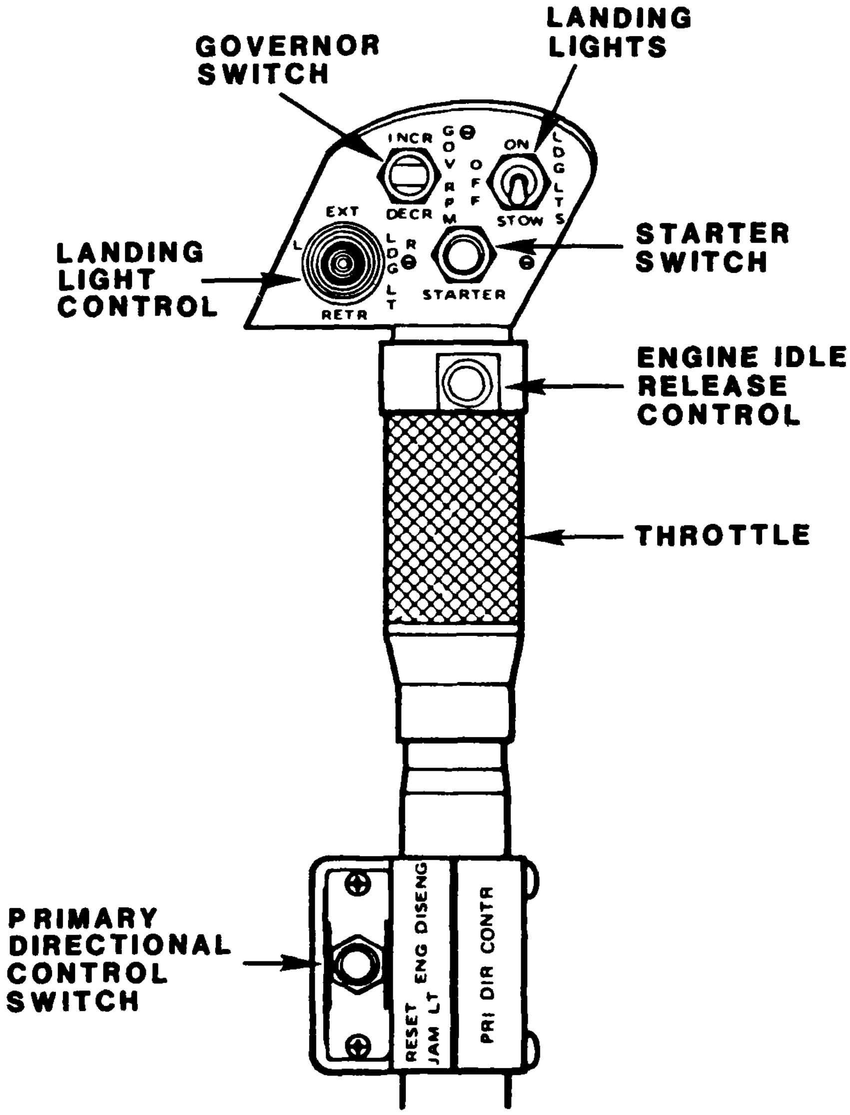

Figure 7. Pilot collective control, OH-58C.
(Adapted from Technical Manual 55-1520-235-10, p. 2-8.)

flight control into rotary-wing aircraft. The data taken from this survey will be used to shape future primary flight control research.

RECOMMENDATIONS

The interview results provide some interesting considerations that should be incorporated into future primary flight control research. First, if conventional system designs are to be modified, their impact on system capability, reliability, and maintainability in addition to feasibility must be demonstrated to users to be fully accepted. Further, the effects of pilot retraining and subsequent negative habit transfer need to be explored to ensure that future aircraft with side-arm, multiaxis primary flight controls can be effectively flown, especially in combat and emergency situations. Next, with respect to operation bias developed from flying one aircraft versus another, it is important to place pilots' opinions within the context of the aircraft they fly in order to accurately apply them. Finally, standardization and optimization of primary flight control configurations are two objectives for future human factors research.

REFERENCES

Aiken, E. (1986). A review of the effects of side-stick controllers on rotorcraft handling qualities. Journal of the American Helicopter Society, 31(3), 27-34.

Black, G., & Moorhouse, D. (1979). Flying qualities design requirements for side stick controllers (AFFDL-TR-79-3126). Wright-Patterson Air Force Base, OH: Air Force Flight Dynamics Laboratory.

DeBellis, W. B. (1987-a). Cross-coupling effects of switch actuation on a four-axis flight control. Unpublished manuscript.

DeBellis, W. B. (1987-b). Four-axis side-arm flight control simulator investigation. Manuscript submitted for publication.

DeBellis, W. B. (1986). Anthropometric considerations for a four-axis side-arm flight controller. Proceedings of the 21st Annual Conference on Manual Control (NASA CP-2428). Washington, DC: National Aeronautics and Space Administration, Ames Research Center, pp. 17.1-17.14.

DeBellis, W. B., & Christ, K. A. (1983). Anthropometric considerations for a four-axis side-arm flight controller (Technical Note 2-86). Aberdeen Proving Ground, MD: U.S. Army Human Engineering Laboratory.

Department of the Army (1980). Operator's Manual on Army Model AH-1S (Prod), AH-1S (Ecas), AH-1S (Modernized Cobra) Helicopters (Technical Manual 55-1520-236-10). Washington, DC: Headquarters.

Department of the Army (1978). Operator's Manual on Army Model OH-58A Helicopter (Technical Manual 55-1520-228-10). Washington, DC: Headquarters.

Department of the Army (1978). Operator's Manual on Army Model OH-58C Helicopter (Technical Manual 55-1520-235-10). Washington, DC: Headquarters.

Geiselhart, R., Kemmerling, P., Cronburg, J., & Thorburn, D. (1970). A comparison of pilot performance using a center-stick vs. side-arm configuration (ASD-TR-70-39). Wright-Patterson Air Force Base, OH: Aeronautical Systems Division.

Hall, G., & Smith, R. (1975). Flight investigation of fighter side stick force deflection characteristics (AFFDL-TR-75-39). Wright-Patterson Air Force Base, OH: Air Force Flight Dynamics Laboratory.

Harvey, D. (1987, January). Shadow's image revealing future LHX possibilities. Rotor & Wing International, pp. 24-26, 67.

Sinclair, M., & Morgan, M. (1981). An investigation of multi-axis isometric side-arm controllers in variable stability helicopter flight (LR-600). Montreal, Canada: National Aeronautical Establishment, Flight Research Laboratory.

Sjoberg, S., Russell, W., & Alford, W. (1957). Flight investigation of a small side-located control stick used with electronic control systems in a fighter plane (NACA RML 56128A). Washington, DC: National Advisory Committee for Aeronautics.

U.S. Army Safety Center. (1986, August 6). Of witches and switches and other scary tales. Flightfax, 14(3), pp. 1-2.

BIBLIOGRAPHY

Thorndike, R. (1982). Applied psychometrics. Boston, MA: Houghton Mifflin Co.

Tull, D., & Alboum, G. (1973). Survey research: A decisional approach. New York: Intext Educational Publishers.

U.S. Army Test and Evaluation Command. (1985). Questionnaire and interview design: Subjective testing techniques (PAM 602-1, Vol. 1). Aberdeen Proving Ground, MD: Author.

APPENDIX A

SIDE-ARM CONTROL STRUCTURED INTERVIEW

SIDE-ARM CONTROL STRUCTURED INTERVIEW

Purpose

In order to improve pilot performance it has been suggested that some combination side-arm, multiaxis/switch isometric control be integrated into helicopter cockpits. The following interview is intended to gather inputs on such a device with respect to its practicality, feasibility, and reliability. Your responses will be used to construct a survey for the Army aviation community. The survey data will facilitate future rotary airframe development.

Demographics

NAME ______________________ RANK __________ AGE __________

No. of Years Rated Aviation Service ______

No. of Flight Hours by Aircraft

TH-55	____________	hours
UH-1	____________	hours
UH-60	____________	hours
OH-6	____________	hours
OH-58	____________	hours
AH-1	____________	hours
CH-47	____________	hours
Other	____________	hours

Highest Rating (P, IP, SIP) __________

Other ____

____

____

Questions

Interview items were taken from the following areas:

- Conventional vs. side-arm controls
- Conventional vs. multiaxis controls
- Conventional vs. isometric controls
- Standardization/optimization of functional switch placements

1. Comparing side-arm to conventional controls, we see certain advantages and disadvantages.

   a. List the advantages you see to utilizing a side-arm control.
   b. List the disadvantages to a side-arm control.

2. Comparing a multiaxis control to conventional controls, we have noted some advantages and disadvantages.

a. List the advantages you see to utilizing a multiaxis control.
b. List the disadvantages to a multiaxis control.

3. Comparing pressure (isometric) controls to conventional (isotonic) controls, we have found some specific advantages and disadvantages; list your

a. Advantages
b. Disadvantages

4. Considering the current placement of buttons and switches on helicopter controls, what recommendations do you have for future aircraft designs (especially if a change to a single multiaxis device is made)?

5. Do you have any general comments to add to what you have already stated?

APPENDIX B

FLIGHT CONTROLLER QUESTIONNAIRE

FLIGHT CONTROLLER QUESTIONNAIRE

Demographic Information: Please fill in the appropriate information that best describes you.

RANK______ AGE______ YEARS OF RATED AVIATION SERVICE______

HIGHEST QUALIFICATIONS (CIRCLE ONE) SP, P, IP, SIP/IFE

NO. OF HOURS PER AIRCRAFT (CIRCLE PRIMARY)

CH-47_____ CH-54_____ TH-55_____ UH-1_____ UH-60_____ OH-6_____ OH-58_____
AH-1_____ AH-64_____ OTHER_____

Directions: Please indicate with an "X" your responses to the following statements.

1. A multiaxis flight control located on the right side of the pilot would be less fatiguing.

strongly agree	agree	indifferent	disagree	strongly disagree

2. A side-arm control device with an armrest would reduce body fatigue.

strongly agree	agree	indifferent	disagree	strongly disagree

3. It is important that the left hand has access to a flight control device.

strongly agree	agree	indifferent	disagree	strongly disagree

4. A multiaxis flight control located in the traditional cyclic position would be preferred to a right-side position.

strongly agree	agree	indifferent	disagree	strongly disagree

5. The direct control of altitude, airspeed, and heading would be preferred to that of pitch, roll, and yaw.

strongly agree	agree	indifferent	disagree	strongly disagree

6. The attitude display should be located close to and in line with the flight control.

strongly agree	agree	indifferent	disagree	strongly disagree

7. The ability to change control characteristics during flight for different conditions (NOE, HOVER, CRUISE, NIGHT) would be desirable.

strongly agree	agree	indifferent	disagree	strongly disagree

8. If a single side-arm flight control were to be used, please number in order of priority the following switch functions that should be located on the control head:

RADIO SELECTION	TRANSMIT	ICS
ARMAMENT SELECTION	ARMAMENT FIRING	VISIONICS (SENSORS, FOVS)
CONTROL STABILIZATION	CARGO HOOK RELEASE	NAVIGATION UPDATING
PANEL LIGHTS KILL	SCAS RELEASE	TARGET DESIGNATION
OTHER________		

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